Center Innovation Fund: JSC CIF

Game Changing Augmented Reality Training and Assistance for Maintenance Repair

Completed Technology Project (2010 - 2013)

Project Introduction

NASA's vision to support human spaceflight missions beyond Low Earth Orbit will require game changing operational toolsets for training and assistance for maintenance operations. With time delays of more than 15 minutes for communications back to earth, astronauts will face the daunting task of operating and maintaining numerous systems that might unexpectedly break or may even be required to perform life-saving surgery without support from the ground operators. Complex assembly and maintenance tasks in space operational environments are excellent targets for Augmented Reality (AR) applications. The need for good training and access to large amounts of documentation are conditions making the use of AR techniques most promising. AR Training and Assistant Systems (AR-TAS) serve as "just-in-time" performance support tools for improving mission timelines while reducing prior training requirements.

The proposed technology reduces crew reliance of ground and paper procedure support in deep-space human spaceflight missions by providing real-time, in situ task guidance, and reducing the training burden by providing all relevant information into the operator field of view. AR has the potential to assist crew in many nominal and off nominal operational procedures execution, thus enabling crew autonomous operation and reducing their dependency on ground support. The marker-less AR system that minimizes tagging logistics and registration is especially attractive for space operations. This technology uses a camera and image processing technique to create a "point cloud" map to register the real-world objects, which then enables the crew to get overlay information directly in the crew's field of view through the AR glasses. Procedure steps and animated 3D overlays of the device being worked on can significantly minimize the maintenance operations difficulty. The project is proposed as a multiyear effort. Three AR prototypes were developed in year one to assess and to demonstrate the feasibility of the technology in the context of electronic procedures and maintenance operations. The second year objectives are to enhance the vision processing capability and to improve robustness of the year one prototypes. If successful, the third year will focus on assessing the feasibility to fly the proposed system as an ISS DTO.

Anticipated Benefits

The ISS Program is striving to minimize crew time spent on maintenance tasks to increase time for science and operating payloads. This project supports that goal by making a complex maintenance task easier to perform by the crew. It has been well documented that on-orbit maintenance of the ARED device has been a time-consuming task for the ISS crew. This could cause a significant impact on crew health if the maintenance procedures are not done correctly. Since the use of electronic procedures for maintenance operations is pervasive across multiple domains, other potential AR applications will

Project Image Game Changing Augmented Reality Training and Assistance for Maintenance Repair

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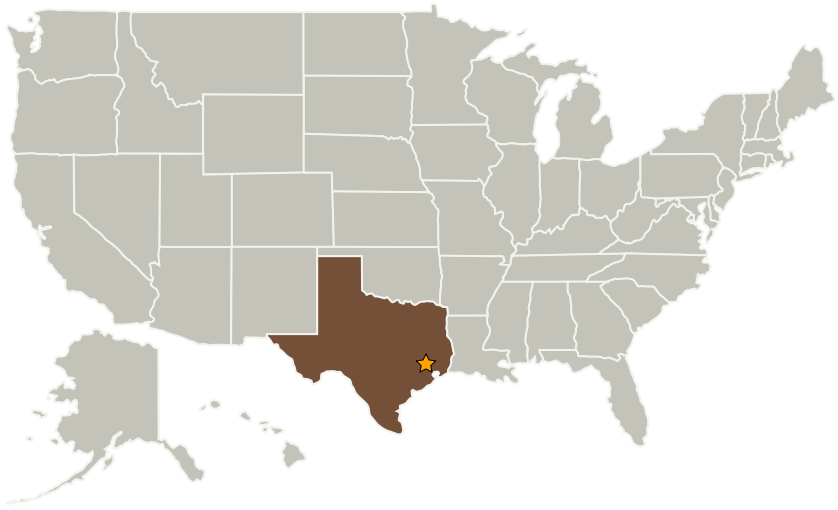
continually be identified for current or future space hardware including ISS Robonaut 2 (ISS-R2), Simplified Aid for EVA Rescue (SAFER), and the maintenance repair of the ISS Waste Hygiene Systems (WHS).

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations
Texas

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Center Innovation Fund: JSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Carlos H Westhelle

Project Manager:

Lui Wang

Principal Investigator:

Lui Wang

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Images

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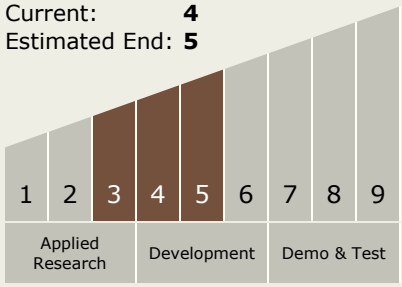
Project Image Game Changing Augmented Reality Training and Assistance for Maintenance Repair
(https://techport.nasa.gov/image/2161)

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **5**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.6 Human Systems Integration
    - TX06.6.6 Maintainability and Supportability